50018

3 October 1969

Mr. Paul S.

Dear Paul:

Enclosed is a summary progress report on Contract [redacted] STAT
The report of progress on the other contract follows. I am sorry about the delay. I've been snowed under.

Best regards,

PHOTOGRAPHIC AND LINE-SCAN IMAGERY EXPERIMENTATION

Summary Progress Report

[redacted] STAT

This is a summary of progress on Contract [redacted] STAT and its extension, Contract [redacted] STAT NPIC [redacted] STAT Thus far the following technical reports have been submitted to the sponsor:

1. *Aircraft image analysis as a function of photographic ground resolution.*
2. *The judged worth of aerial photographs as a function of stereoscopic convergence and obliquity angles.*
3. *The judgment of stereoscopic depth in photographs as a function of convergence and obliquity angles.*
4. *The judged worth of aerial photographs as a function of obliquity angle with scale constant.*
5. *The measurement of photographic images by human operators.*
6. *The analysis of missile sites as a function of photographic ground resolution.*
7. *The analysis of radars as a function of photographic ground resolution*

The methods employed and the results of the studies have been described orally to the professional PIs who participated in the studies, as well as to senior representatives of the sponsor, its parent organization, and the military services.

To summarize briefly, Studies 1, 6, and 7 were investigations of the ground resolutions required by

photointerpreters to obtain the essential elements of information about three types of targets: aircraft, offensive missile sites, and mobile radars. The results of all three studies showed that the amount of additional significant information obtained diminishes rapidly as the "very good" end of the scale of ground resolutions investigated is approached. The implication of the results is that the costs of obtaining "very good" ground resolutions may not be justified.

An unexpected result of the radar study was the fact that the PIs correctly identified the function of all nine radars at the poorest ground resolution [redacted] They did this in spite of the fact that the radars, which actually were models, were not located in their natural context. (When we briefed [redacted], he found this result unbelievable. Later on the same day when we gave a briefing on the third floor of NPIC, we asked the PIs who participated in the study if they found this result surprising. They reported that they did not.) STAT STAT

The results of Studies 2, 3, and 4 had very significant implications for the design of camera systems. It was found that a 20° convergence angle system is equally as good for photographic interpretation as a 30° convergence angle system. (Surprisingly, two of the 16 PIs who served as subjects in the studies apparently could not "see" stereo.) A 20° convergence angle camera is easier to design, operates better, weighs less, and costs less to manufacture than the traditional 30° convergence angle camera. Though no figures are available, the results of this series of studies likely have saved and will save the government an enormous amount of money.

The mensuration study, 5, was designed to determine the effects on the accuracy of horizontal measurement of

image edge spread in five equal steps from 5 to 25 microns, modulation in five equal steps from .1 to .5, edge shape and object size. Six experienced personnel made a total of 32,940 measurements. The results were presented in tabular form so that the precision of operational measurements could be improved by simply referring to the table representing the operational photography in terms of the independent variables in the study: edge spread, modulation, and target shape and size. Also, the results can be incorporated into NPIC's photogrammetric computer program.

At the request of the sponsor, special projects have been conducted from time to time. These projects have been diverse: the development of a two-week technical briefing, the evaluation of different types of photography for research on photointerpretation and mensuration, participation in developing recommendations for collection of operational materials, consultation with representatives of the sponsor and other contractors on exploitation methods, and others. Technical memoranda describing these special projects have been submitted to the sponsor.

A joint effort is currently being conducted by The [redacted] on line-scan images. This STAT
work is being supported in part by the parent organization of NPIC and the Army. The work is certainly relevant to the NPIC's activities. The hardware required for a real-time, line-scan sensor system has been under serious investigation by several government agencies, and the sponsor will likely be exploiting line-scan imagery in the future. But little work has been done to answer important questions regarding the display of line-scan images. The joint [redacted] effort is designed to answer some of STAT
them, such as:

How many lines per scene object (target) are required for classification and identification? For noiseless imagery? For different signal-to-noise ratios?

How many shades of gray are required for target identification?

What are the trade-offs between lines per scene object and shades of gray? Between lines per scene object and signal-to-noise ratio?

The answers to such questions have significant implications for system design--for example, bandwidth requirements--and for decisions concerning the trade-off between cost and system capability.

Earlier this year we proposed to investigate the relation between the results of our work on reconnaissance photography and the results of the line-scan imagery research.

The initial study was designed and conducted during the past summer. It was a complete replication of the Hollanda, Scott, Harabedian study of the effects on target identification of signal-to-noise ratio and numbers of scans per target. In addition, photographic images of comparable quality and of the same targets were included in the identification task. The conditions of the line-scan study are illustrated below.

Signal-to-Noise Ratio

Scans per Target	3	5	10	20	∞
16					
32					
48					

The line-scan images were produced from original negatives of models of military vehicles using the line-scan image generator conceived and designed by [redacted] College students served as subjects. STAT

In the study conducted last summer, in which both line-scan and photographic stimulus materials were used, there were five photographic ground resolutions; they were comparable to the five line-scan signal-to-noise ratios. Professional photointerpreters, 40 from NPIC and 10 from [redacted] served as subjects. STAT

The data analysis was done on the [redacted] computer and the report is now being prepared. It will be completed this month. STAT

On September 26, 1969, there was [redacted] remaining on the contract. No additional funds will be required to complete the report. STAT

October 6, 1969

Mr. Paul S.

Dear Paul:

Enclosed is a summary progress report on Contract Number [redacted] WR. STAT

Best regards,

Declassified in Part - Sanitized Copy Approved for Release 2012/08/22 : CIA-RDP79B00873A001600040029-3

THE EFFECTS OF PHOTOGRAPHIC GROUND RESOLUTION ON PHOTOINTERPRETATION

Summary Progress Report

STAT

STAT

The results of the aircraft, missile, and radar studies done under Contract [redacted] had very significant implications concerning operational system requirements. However, it was felt that the effects of ground resolution on the identification of additional classes of targets should be investigated. As a result of discussions with representatives of the sponsor and other organizations, we proposed to make preparations to study ground order-of-battle targets. We proposed to perform the following tasks:

Task 1. Selection and procurement of the required aircraft and camera.

Task 2. Selection, procurement, and placement of appropriate targets.

Task 3. Construction or procurement and placement of test targets.

Task 4. Collection of "ground truth" information.

Task 5. Collection of photography.

The photographic acquisition requirements we established were as follows:

1. One inch ground resolution as determined from one cycle on a bar target.

2. Stereo availability. A 20% convergence angle or 60% overlap.

3. A frame camera flown in a vertical position. Conventional black-and-white film.

4. Little haze, minimum cloud cover, and a sun angle of about 60° above the horizon.

5. Original negative processed with a density wedge.

In conjunction with the sponsor and [redacted] STAT [redacted] STAT we investigated the camera systems and vehicles that could fulfill the project requirements. We discovered that there were few in existence. We were fortunate to obtain the required aircraft and camera system from NPIC's parent organization.

Arrangements were made with Army personnel at Aberdeen Proving Grounds to photograph the vehicles and weapons in the museum there and other ground order-of-battle targets. Also, permission was obtained to place test targets on the ground and to obtain "ground truth" data, measurements, and ground photographs of the targets.

After the flight plan had been prepared, and appropriate test targets had been put in place, flights were made to determine the altitude and camera setting that would be necessary to meet the photographic acquisition requirements. This was a time consuming process primarily because of poor weather conditions. There were also problems with the camera and film processing. On September 17, the acquisition flight was flown. An effort was made to get all of the targets in the Aberdeen museum covered in one or two frames. [redacted] and we are currently assessing STAT the photography. The initial evaluation indicates that the mission was extremely successful.

As of September 22, no charges had been made to the contract. Costs remaining [redacted] STAT